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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. |
|-----------------|-------------|----------------------|---------------------|
| 08/856,116 | 05/14/97 | CHEN | F AMAT/1931 |

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| EXAMINER |
|------------|
| PERALTA, G |

| ART UNIT | PAPER NUMBER |
|----------|--------------|
| 2814 | |

DATE MAILED: 04/25/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.

08/856,116

Applicant(s)

CHEN ET AL.

Examiner

Ginette Peralta

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 15 February 2001.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 15-18, 21 and 23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 15-18, 21 and 23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

- 15) ☒ Notice of References Cited (PTO-892)
- 16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 18) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 19) ☐ Notice of Informal Patent Application (PTO-152)
- 20) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 15-18, 21 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Taguchi et al. (U.S. Pat. 5,308,793) in view of Zhao et al. (U.S. Pat. 5,674,787) and Sliwa et al. (U.S. Pat. 4,962,060).

Taguchi et al. teaches a method of filling a feature in a dielectric layer that comprises depositing a first barrier layer 21 over a blanket dielectric layer 20, forming a feature through the barrier layer and the dielectric layer to expose an underlayer, depositing a second barrier layer 22 on a bottom and sidewalls of the feature, and depositing a metal layer on the underlayer exposed in the feature, wherein the first and second barrier layers are comprised of silicon nitride (Si_xN_y) and formed using chemical vapor deposition techniques, wherein the second barrier layer is removed from the bottom of the feature by sputter etching techniques, wherein the underlayer may comprise one of a source region or underlying interconnect of aluminum, and wherein the metal layer comprises a titanium or titanium nitride layer and aluminum.

Taguchi et al. teaches all the limitations in the claims with the exception of selectively depositing the metal layer on the underlayer exposed in the feature, and the metal layer comprising copper.

Zhao et al. teaches a method of filling a feature in a dielectric layer that comprises a blanket dielectric layer 12 of silicon oxide, forming a feature through the dielectric layer 12 to expose an underlayer, depositing a barrier layer 16 on a bottom and sidewalls in the feature, removing the barrier layer 16 formed at the bottom of the feature, and selectively depositing a metal layer on the underlayer exposed in the feature, wherein the metal layer comprised copper and the underlayer exposed comprises titanium nitride on which the copper is selectively deposited, for the purpose of using copper as the metallization metal because the use of aluminum, as used by Taguchi et al., is expensive and the hot physical vapor deposition of aluminum requires very high process temperatures that at times are not compatible with the manufacturing of integrated circuits.

Therefore, it would have been obvious to one of ordinary skill in the art to form a titanium nitride on the underlying interconnect of Taguchi et al. for the disclosed intended purpose of Zhao et al. of serving as an antireflection coating and as an electromigration/stress migration suppression layer, and to selectively deposit the copper layer on the titanium nitride of the underlayer exposed in order to form an interconnect of copper that requires lower process temperatures and to use a process of

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selective deposition as copper is difficult to etch and this would eliminate or minimize a post-deposition etch-back step.

With regards to the feature of the deposition of the metal layer using electroplating techniques, Taguchi et al. as modified by Zhao et al. above, teaches the electroless plating of copper on a seed layer of the underlayer. It is well known and desirable in the art to use electroless plating and electroplating for the deposition of copper as both techniques are shown that it is well known and desirable in the art to in the art and widely used, for example Sliwa et al. teaches in Col. 7, ll. 41-51.

Thus it would have been obvious to one of ordinary skill in the art to use electroplating or electroless plating techniques for the formation of copper as both processes are conventional and shows that it is well known and desirable in the art to techniques in the art.

Response to Arguments

3. Applicant's arguments with respect to claims 15-18, 21, 23 have been considered but are moot in view of the new ground(s) of rejection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ginette Peralta whose telephone number is (703)305-7722. The examiner can normally be reached on Monday to Friday 8:00 AM-4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (703)306-2794. The fax phone numbers


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for the organization where this application or proceeding is assigned are (703)308-7722 for regular communications and (703)308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)308-0956.

GP

April 21, 2001


Olik Chaudhuri
Supervisory Patent Examiner
Technology Center 2800